

A REVISION OF THE GENUS *PHRYGANIDIA* PACKARD,
WITH DESCRIPTION OF A NEW SPECIES
(LEPIDOPTERA: DIOPTIDAE)

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Abstract.—The genus *Phryganidia* Packard (Lepidoptera: Dioptidae) is revised and a new species, *Phryganidia chihuahua*, is described. Following a brief review of the Dioptidae, the three species of *Phryganidia* and the placement of the genus are discussed. Six autapomorphies for *Phryganidia* are identified. Relevant morphological characters are illustrated and distributional data are presented.

When I began studying the systematics of the Dioptidae, John Burns presented me with a copy of a poem he had written entitled "In Temperate Spring" (1986). The last two lines read, "Like the California oak-moth, I'm a mindless *Phryganidia*." As the ironies of life would have it, I now find myself revising the genus.

To most North American entomologists, *Phryganidia californica*, the California Oak Moth, is the only member of the obscure family Dioptidae with which they are familiar. However, the family contains nearly 400 species (Bryk, 1930), all of which, with the exception of *P. californica*, occur from Mexico south to Uruguay and Argentina. Most dioptids are relatively small, light-bodied, brightly colored moths that appear to mimic members of groups as disparate as the Pericopinae and Lithosiinae in the Arctiidae, and the Ithomiinae in the Nymphalidae. The 39 other dioptid genera will be the subject of future publications; this paper concerns the species of *Phryganidia*. Because the Dioptidae are so poorly understood, it is necessary to review briefly the taxonomic history of the family and de-

scribe some of the morphological characters that previous authors have discussed.

Ever since the family was erected by Walker in 1865, its phylogenetic position has been controversial. After examining the larva and pupa of *Phryganidia californica*, it was Packard's (1895) opinion that the Dioptidae were closely related to the Geometridae. Dyar (1896) suggested that the group was associated with the Pericopinae. Forbes (1916) argued that dioptids belonged to the Noctuid/Arctiid lineage within the Noctuoidea, but subsequently (1922) followed Fracker (1915) and Mosher (1916) in moving them to a position close to the Notodontidae, a relationship with which all researchers have since agreed. Not until Minet (1983) was a significant change in the phylogenetic position of the Dioptidae proposed. Minet argued that the group should be recognized as a tribe, the Dioptini, within the Notodontinae, but he was uncertain about the tribe's affinities within that subfamily. Minet based his proposal on a single character complex, the structure of the last pair of larval prolegs.

Several character complexes have figured

prominently in theories concerning dioptid relationships. The structure of the dioptid tympanum indicates a close relationship with the Notodontidae. The Noctuoidea (*sensu* Hodges et al., 1983; Watson et al., 1980) can be defined by the presence of a thoracic tympanum (Richards, 1933; Brock, 1971; Minet, 1983), and only in the Diop-tidae and Notodontidae is the tympanal membrane directed ventrally (Richards, 1933; Sick, 1940; Kiriakoff, 1950a, b, c, 1963; Minet, 1983). Variation in tympanal structure within the Diop-tidae has also received considerable attention (Sick, 1940; Kiriakoff, 1950a).

Since Fracker (1915), many authors have recognized a similarity between the larvae of *Phryganidia* and those of notodontids. Minet (1983) described the anal prolegs of diop-tids as being 'reduced or absent' and claimed that this apomorphic character state is shared with the Notodontinae. I have examined larval specimens representing the dioptid genera *Phaeochlaena*, *Phryganidia*, *Zunacetha*, and *Josia*. The anal prolegs are sometimes elongate (e.g., *Phaeochlaena gyon*, figured in Bastelberger, 1908), but they are not "reduced or absent" as Minet suggested. His hypothesis is therefore in doubt.

Wing venation has provided the majority of characters previous authors have used to define dioptid genera (Prout, 1918; Hering, 1925; Bryk, 1930), but offers little information concerning higher-level relationships. All species are "trifid" in the fore and hind wings (M_2 being closer to M_1 than to M_3), a plesiomorphic character state shared with the Notodontidae and many lepidop-teran families (see Forbes, 1948). Two characters that are frequently observed in the Notodontidae, the presence of an "accessory cell" in the fore wing (Forbes, 1942, 1948), and Sc in the hind wing being parallel with R for two-thirds the length of the discal cell (Franclemont, 1970), do not occur in diop-tids.

As this discussion indicates, the phylo-genetic position of the Diop-tidae remains

unresolved. Available evidence strongly supports a relationship with the Notodon-tidae but is inadequate to allow a more pre-cise hypothesis. Until more becomes known it seems better to retain family-level status for the group.

No autapomorphies for the Diop-tidae are known, but a character of the larvae appears promising. The larval skin of all species I have examined is covered with microscopic cuticular projections, described by Fracker (1915) for *Phryganidia californica*. This condition has also been termed "minutely rugose" (Forbes, 1942) or "shagreened" (Peterson, 1965). The presence of these cuticular projections may ultimately prove to be a synapomorphy for the Diop-tidae, but it is important that the immatures of very few species have been collected.

Phryganidia has historically included only two species. Packard (1864) described the genus in the subfamily Psychinae (Bom-bycidae), with *P. californica* as the type species. He chose the name to note conver-gent similarities between these moths and trichopteran species in the Phryganidae. *Phryganidia* was subsequently referred to the Zygaenidae (Stretch, 1872), and finally to the Diop-tidae (Kirby, 1892). Like *P. cal-ifornica*, *P. naxa* was originally placed with the psychids. Druce (1885) described *P. naxa* in the psychid genus *Typhonia* Bruand. Prout (1918) united both species in the Diop-tidae as members of *Phryganidia* but expressed doubt as to the correct affinity of *P. naxa*. The only other taxon that has been named, *fasciata*, was described by Hering (1928) as a form of *P. naxa*. This paper treats these three taxa and describes a new species, *P. chihuahua*.

METHODS

Morphological terminology of the head and antennae follows Forbes (1923) and Hodges (1971). Names for the structures of the genitalia follow Klots (1970) and Hodges (1971). However, the homology of lepidop-teran genitalic structures needs careful study.

For example, it is uncertain whether the terms *socii*, *uncus*, and *transtilla* used here to describe dioptids are homologous with structures in other groups to which the same names have been applied. I will use the terms while recognizing that future research is essential. The color guide of Smithe (1975) was followed as closely as possible in descriptions of vestiture and wings.

Genitalia and adomens were prepared by soaking the entire abdomen in 10% KOH for 12–15 hours. Specimens were placed in 20% ethanol and the abdomen was cut longitudinally along the pleural membrane on the right side. The terminalia were then separated from the rest of the abdomen and scales and soft tissues were removed with a brush. The aedoeagus was removed, and the vesica was inflated using fluid pressure from a syringe inserted in the anterior (proximal) end of the aedoeagus. The bursa was similarly inflated using a syringe inserted in the ostium. Preparations were then stained for 10 to 20 seconds in Chlorazol Black (ICN Pharmaceuticals), followed by one hour in Safranin O (Wards's Natural Science Establishment), and mounted on slides. Line drawings were made using a camera lucida attached to a Wild M5 dissecting microscope. Lateral views of genitalia were drawn from specimens in ethanol. Drawings of palpi, legs, anal views of male genitalia, aedoeagi, and tergites/sternites were made from specimens mounted on slides in Canada Balsam.

Scanning electron micrographs were taken with a Cambridge Scan 100 microscope. Specimens were mounted on stubs and sputter-coated with gold/palladium. Before being mounted, antennae were cleaned by rinsing them for several minutes in 95% ethanol. The thorax of dried specimens was carefully brushed free of scales for micrographs of the tympanum. Preserved pupae were removed from ethanol and air dried before being mounted and sputter-coated.

Acronyms for museums are as follows: American Museum of Natural History, New

York, (AMNH); British Museum (Natural History), London, (BMNH); Canadian National Collections, Ottawa, (CNC); Cornell University Insect Collections, Ithaca, (CU); Carnegie Museum of Natural History, Pittsburgh, (CMNH); Essig Museum of Entomology, Berkeley (UCB); Natural History Museum of Los Angeles County, Los Angeles, (LACM); Museum of Comparative Zoology, Cambridge, (MCZ); National Museum of Natural History, Washington, (USNM).

Genus *Phryganidia* Packard

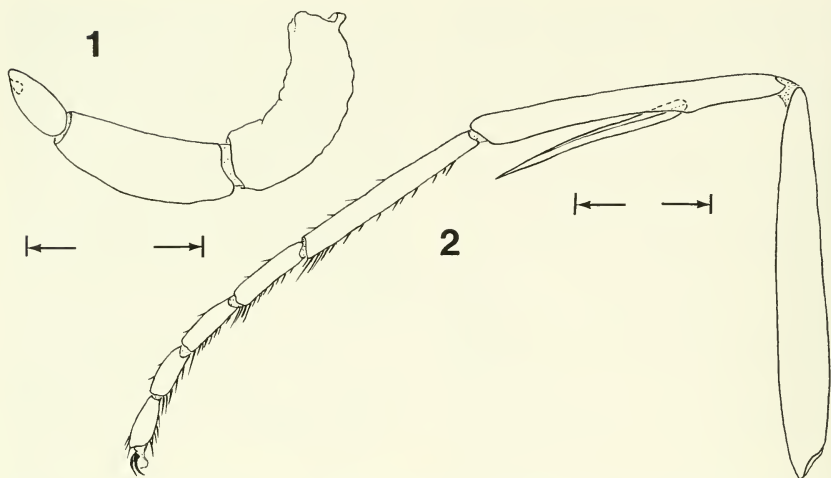
Phryganidia Packard, 1864: 348 [type species: *Phryganidia californica* Packard by monotypy].

Diagnosis.—Small to medium-sized moths, fore wing length 12 to 22 mm. Mostly light brown to gray-brown.

Adult.—*Head*: Labial palpi upturned to just above clypeus, segment 2 slightly longer than segment 1 (Fig. 1). Antennae of male widely bipectinate (Fig. 4), those of female narrowly bipectinate (Fig. 5).

Thorax: Pleural region and tegulae covered with long, hair-like scales. Epiphysis long and slender (Fig. 2), reaching to distal end of tibia or beyond. Fore wing (Fig. 3) with R_1 arising from discal cell, other radials in the pattern $R_2 + [(R_3 + R_4) + R_5]$; M_3 and CuA_1 stalked; posterior angle of discal cell oblique. Hind wing with M_3 and CuA_1 stalked, posterior angle of discal cell oblique. Tympanal membrane not enclosed by metepimeron (Figs. 6 and 7).

Male abdomen (Figs. 10, 15, 18, 20): Tergite VIII arched dorsally, anterior margin slightly emarginate; posterior margin weakened medially, with numerous membranous folds and 2 lateral excavations. Posterior margin of sternite VIII excavated medially, with a pair of sclerotized lateral pockets; a single broad, blunt apodeme on anterior margin. Genitalia with uncus broad and hood-like, ventral surface covered with a mat of short setae; *socii* elbowed, with



Figs. 1, 2. 1, Right labial palpus of *Phryganidia californica* male in lateral view (California, AMNH slide no. JSM 110; scale line = 0.5 mm). 2, Left fore leg of *Phryganidia chihuahua* male in lateral view (Mexico, CNC slide no. JSM 115, scale line = 1.0 mm).

short, spine-like setae; anal tube kinked distally; valvae with a small lateral patch of androconial scales, a short process at dorsal margin of apex; sacculus small; arms of transtilla narrow, meeting above aedeagus anteriorly. Aedeagus short, with a ventral tooth and small dorsal sclerite distally; vesica with 15 to 25 spine-like cornuti.

Female abdomen (Figs. 11, 19): Genitalia with ostium simple; ductus bursae short; corpus bursae with small spicules at base and a pair of small signa; posterior margin of tergite VIII with a pair of long, slender projections. Posterior margin of sternite VII excavated medially.

Immatures.—Larvae with skin shagreened; anal prolegs not elongate, crochets present. Pupae with hook-shaped setae on dorsum of abdominal segments 7–10 and on cremaster (Figs. 8 and 9).

Natural history.—Within the genus only the immatures of *P. californica* are known. The larvae feed on many oak species (Tietz, 1972), often causing severe defoliation

(Brown and Eads, 1965). Its primary host is *Quercus agrifolia* (Volney et al., 1983; Puttick, 1986). Largely as a result of its economic importance, *P. californica* has been the subject of ecological (Harville, 1955), physiological (Volney et al., 1983; Puttick, 1986), and bio-control (Milstead et al., 1980) research. Hochberg and Volney (1984) found evidence of a female produced pheromone. The parasites of *P. californica* have been studied by Young (1982, and references therein).

Apomorphies.—Of the morphological characters described above, the following appear to be autapomorphies for *Phryganidia*: 1) Epiphysis long and slender; 2) Posterior margin of male tergite VIII with numerous folds and two lateral excavations; 3) Posterior margin of male sternite VIII with a pair of sclerotized, lateral pockets; 4) Uncus broad and hood-like; 5) anal tube with a distal kink; and 6) Posterior margin of female tergite VIII with a pair of long, slender projections.

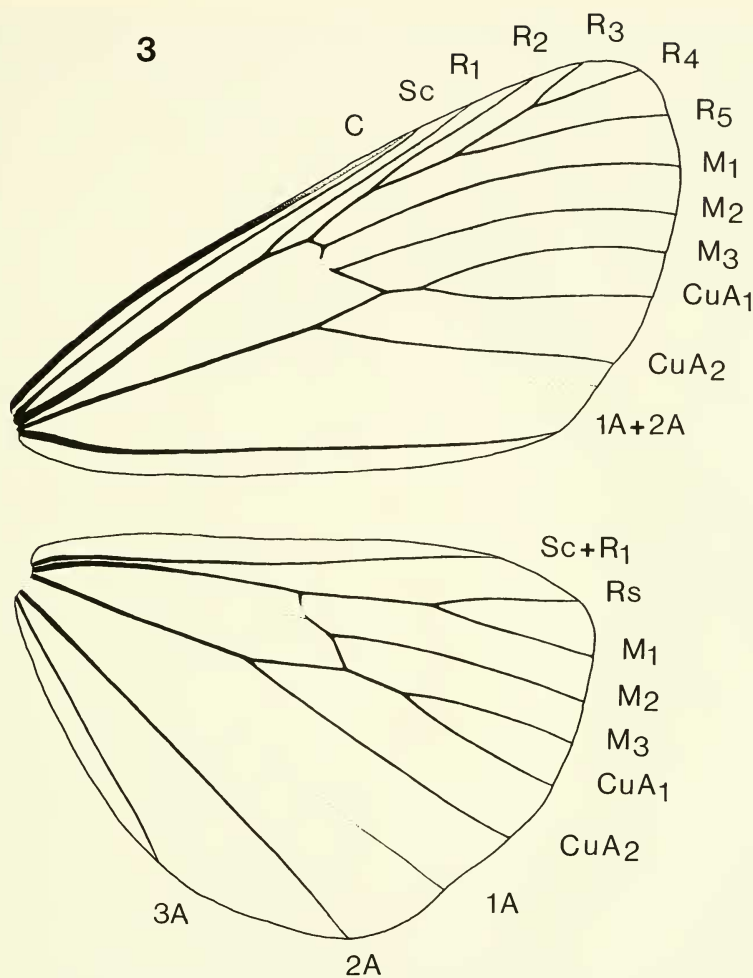


Fig. 3. Fore and hind wing venation of *Phryganidia chihuahua* (Mexico, CNC slide no. JSM 114). A, anal vein; C, costal vein; CuA, cubito-anal vein; M, medial vein; R, radial vein; Rs, radial sector; Sc, subcostal vein.

KEY TO THE SPECIES OF
PHRYGANIDIA PACKARD

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. Ground color of fore wings gray-brown, hind wings charcoal gray <i>P. naxa</i> Druce</p> <p>- Ground color of fore and hind wings concolorous 2</p> | <p>2. Ground color light brown; tegulae buff-yellow; fore wing length 12 to 18 mm
..... <i>P. californica</i> Packard</p> <p>- Ground color gray-brown; tegulae gray-brown; fore wing length 19 to 22 mm
..... <i>P. chihuahua</i>, new species</p> |
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Phryganidia californica Packard

Figs. 1, 4-14

Phryganidia californica Packard, 1864: 348.

Diagnosis.—Fore wing length 12 to 18 mm. Ground color lighter than other species in the genus.

Head: Scales on first two segments of labial palpus buff-yellow, third segment light gray-brown; front tan to light gray-brown. Antennae black ventrally, light gray-brown scales dorsally.

Thorax: Legs, pleural region, and dorsum gray-brown; patagia buff to light brown; tegulae buff-yellow. Wings translucent, light brown; dorsal surface of male fore wing with a cream colored fascia beyond discal cell, fascia fainter below.

Abdomen: Light brown. Male terminalia as in Fig. 10; sternite VIII with a large, membranous "window"; a small patch of androconial scales on lateral surface of valvae. Female terminalia as in Fig. 11; sternite VII with short, lateral processes on anal margin, largely membranous medially; tergite VIII with a membranous region medially; corpus bursae with two small patches of spicules at base and two indistinct, spiculate signa.

Type material.—The male lectotype, herein designated, bears three labels: "San Mateo, California, [no date], A. Agassiz"; a red label stating "MCZ Type 23388"; and an "A.S. Packard Type" label. It is in fair condition and is in the MCZ. A second male with the same label data is here designated as a paralectotype.

Other specimens examined.—64 ♂, 32 ♀ (USNM); 82 ♂, 21 ♀ (AMNH); 32 ♂, 4 ♀ (CMNH); 9 pupae, 25 larvae (USNM). Dissected 5 ♂, 5 ♀.

Distribution.—Oregon. Two localities in Lane County (Wickman and Kline, 1985). California. Happy Camp, Siskiyou County (CMNH); Overwintering from southern Mendocino County south to San Diego, inland only in the Riverside area (Fig. 14). Also recorded from the Channel Islands

(Anacapa, Santa Cruz, and Santa Rosa Islands), and Catalina Island. A single specimen in the USNM labeled "Cn[Canyon] de las Cruces, Baja California, Mexico." Two specimens (one from the AMNH and one from the LACM) are recorded as being from Arizona.

Phryganidia chihuahua J. Miller,

NEW SPECIES

Figs. 2, 3, 15-17

Diagnosis.—Fore wing length 19 to 22 mm. This is the largest of the three *Phryganidia* species. It is darker than most specimens of *P. californica*, the species with which it is superficially most similar. Female specimens are not known.

Head: Scales on first segment of labial palpus light yellow, second and third segments gray-brown; front light yellow, gray-brown at outer margins; antennae black ventrally, dark gray-brown scales dorsally.

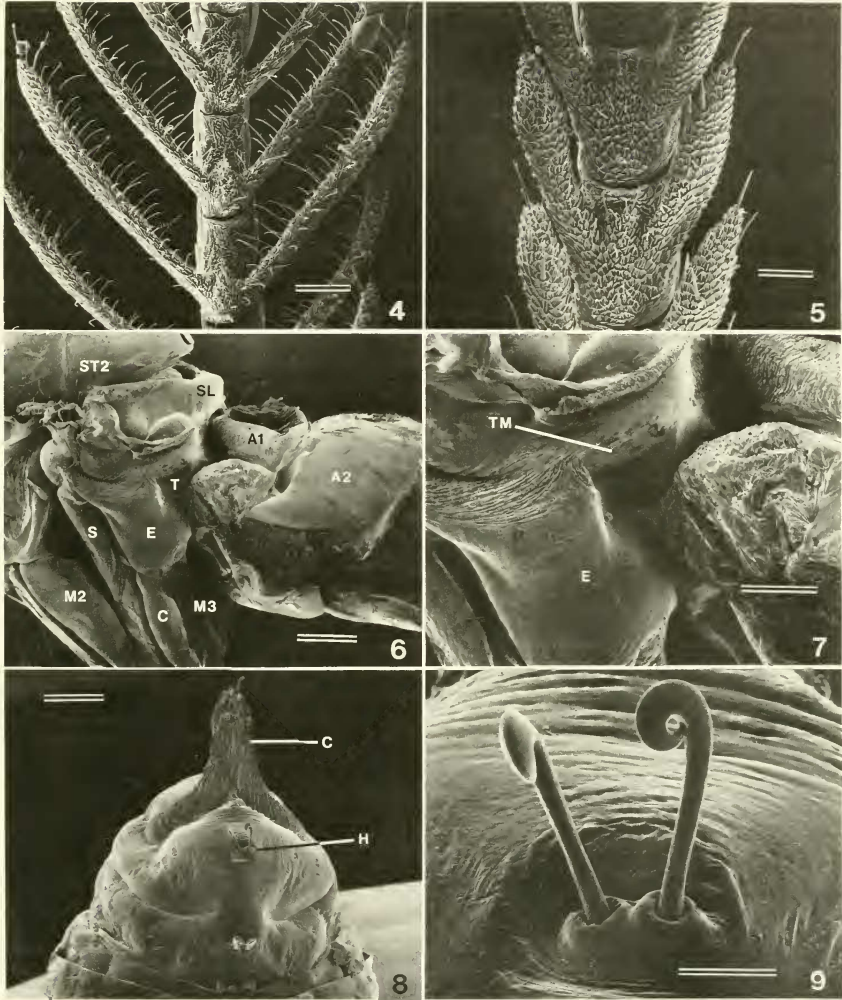
Thorax: Legs, pleural region, dorsum, and tegulae gray-brown; patagia light yellow. Wings gray-brown, translucent, without markings either above or below; (a single specimen with a faint fascia beyond discal cell).

Abdomen: Gray-brown. Male terminalia as in Fig. 15; anterior apodeme of sternite VIII broad; valvae narrow, a small patch of androconial scales on lateral surface.

Type material.—The holotype male (Fig. 16) bears two labels. The first has the data: "Mexico. Chi[huahua], Mesa del Huracan, 108°15'30"4', 7400', VIII-21-25-1964, J. E. H. Martin." The second is a "holotype" label with red lettering. The specimen is in excellent condition and is deposited in the Canadian National Collections, Ottawa. Paratypes: 9 ♂, all with the same label data as the holotype. Dissected 3 ♂.

Other specimens examined.—Mexico. Durango, El Salto, 28 mi E, 8000', VII-22-64, J. Powell (1 ♂, UCB).

Distribution (Fig. 17).—Known only from two localities; the type-locality, and El Salto, Durango.



Figs. 4-9. Scanning electron micrographs of *Phryganidia californica*. 4, Male antenna (ventral view, scale line = 100 μ m). 5, Female antenna (ventral view, scale line = 100 μ m). 6, Meso- and metathoracic segments plus first two abdominal segments (anterior at left, scale line = 0.5 mm). A1, abdominal tergite 1; A2, abdominal tergite 2; C, metacoxa; E, metepimeron; M2, mesomeron; M3, metameron; S, metepisternum; SL, metascutellum; ST2, mesoscutum, T, tympanum. 7, Metathoracic and first abdominal segments (anterior at left, scale line = 250 μ m). E, metepimeron; TM, tympanal membrane. 8, Terminal segments of pupa (dorsal view, scale line = 0.5 mm). C, cremaster; H, hook-shaped setae on segment 10. 9, Hook-shaped setae on segment 10 of pupa (scale line = 100 μ m).

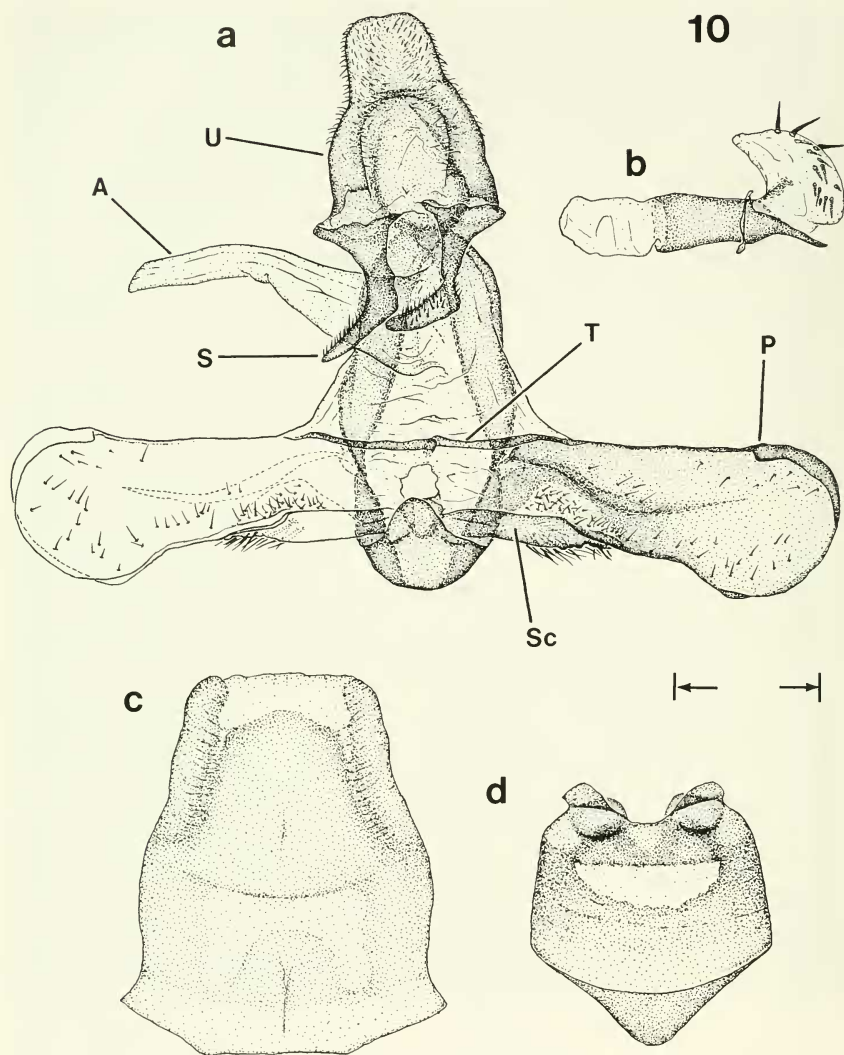


Fig. 10. Male terminalia of *Phryganidia californica* (California, AMNH slide no. JSM 110; scale line = 1.0 mm). 10a, Genitalia in anal view with aedeagus removed. A, anal tube; P, apical process; S, socius; Sc, sacculus; T, transtilla; U, uncus. 10b, Aedeagus in lateral view (anterior at left). 10c, Tergite VIII in dorsal view. 10d, Sternite VIII in ventral view.

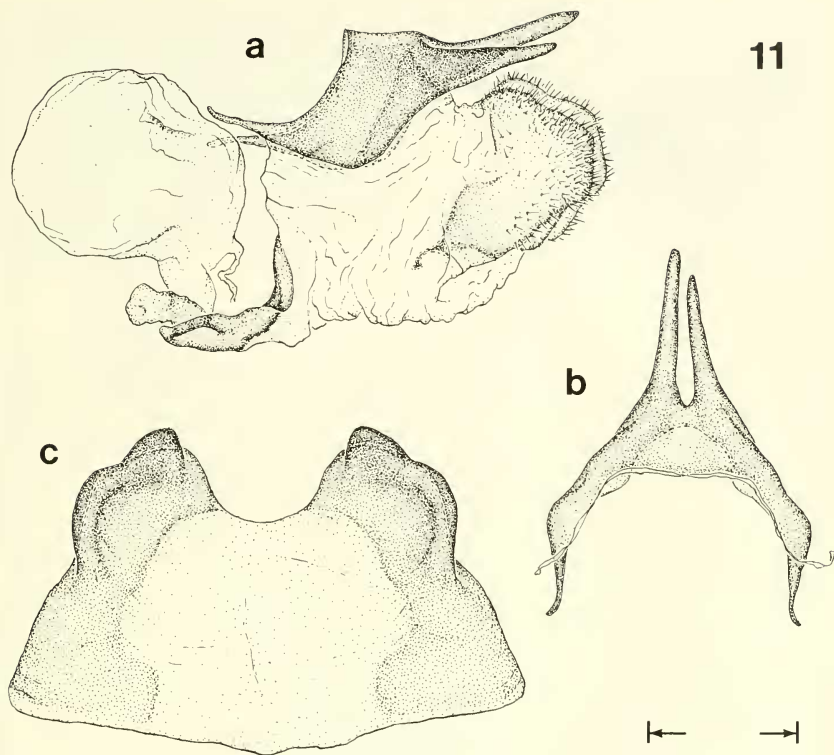


Fig. 11. Female terminalia of *Phryganidia californica* (California, USNM slide no. 29171; scale line = 1.0 mm). 11a, Genitalia in lateral view (anterior on left). 11b, Tergite VIII in dorsal view. 11c, Sternite VII in ventral view.

Etymology.—A noun in apposition. The name comes from the type locality.

Remarks.—*Phryganidia chihuahua* and *P. californica* are more similar in habitus than either is to *P. naxa*, but without females of *P. chihuahua* there is insufficient character information to resolve relationships within the genus.

Phryganidia naxa Druce
Figs. 18–26

Typhonia naxa Druce, 1885: 229.

Phryganidia naxa: Prout, 1918: 412.

Diagnosis.—Fore wing length 12 to 18 mm. The fore wings are narrower and the

hind wings less full than in the other *Phryganidia* species. In addition, the wings are not concolorous and are only slightly translucent (not at all in males).

Head: Scales on labial palpus and front uniformly gray. Antennae black ventrally, dark gray scales dorsally.

Thorax: Legs, pleural region, patagia, dorsum, and tegulae gray. Males (Figs. 21, 23–26) with fore wing ground color gray-brown, ventral surface with a yellow fascia beyond discal cell; some color forms (*fasciata* of Hering, Fig. 21) with an equivalent fascia on dorsal surface as well. Males with hind wings charcoal gray above and below.



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Figs. 12, 13. *Phryganidia californica* (dorsal view). 12, Male; 13, Female.

Females with fore wings gray-brown, hind wings charcoal gray; slightly translucent; without markings either above or below. A single male specimen from Guatemala (Figs. 20, 25, 26) with a light yellow longitudinal stripe on ventral surface of fore wing from base stopping short of fascia; a longitudinal orange-yellow stripe on both surfaces of hind wing from base stopping short of outer margin; fringe scales on anal margin yellow.

Abdomen: Gray, lighter ventrally. Male genitalia as in Figs. 18 and 20; costa of valve expanded; uncus bulbous. Female genitalia as in Fig. 19; corpus bursae with a sclerotized region and two patches of spicules at base; two more or less distinct, spiculate signa.

Type material.—The female lectotype (Fig. 22), herein designated, is labeled "Guatemala City, 5000 feet, [no date], Champion." It bears two additional labels: "B.C.A. Lep. Het. Typhonia naxa," and "Godman-Salvin Coll. 98.-40." A third handwritten label by D. Goodger reads "probable syntype of *naxa* Druce." It is in good condition and is in the British Museum (Natural History). A female with the data: "S. Geronimo, [no date], Champion," and bearing a blue, circular "syntype" label is here designated as a paralectotype. It has no abdomen and is in rather poor condition.

Other specimens examined.—Guatemala. [18]87-88, Conradt, det. Martin Hering

(1 ♀, BMNH); [no date], B. Bruckner S.G., (form "*fasciata*") det. Martin Hering (1 ♂, BMNH); Guatemala City, Sept. & Nov. [no year], Schaus and Barnes (2 ♂, USNM); Volcan de Santa Maria, Nov. [no year], Schaus and Barnes (1 ♀, USNM). Mexico. Nuevo Leon, Chipinque Mesa, 4300', IX-19-20-1975 (at light), J. Powell, J. Chemsak, and T. Friedlander (14 ♂, 4 ♀, UCB); Nuevo Leon, 4 mi W Iturbide, 5500', IX-25-1975 (black-light trap), J. Powell, J. Chemsak, T. Friedlander (1 ♂, UCB); Nuevo Leon, 6.4 km W Iturbide, 24°44'N-99°56'W, 1800 M, VII-16-79, D.C. Darling (1 ♂, CMNH). Dissected 6 ♂, 3 ♀.

Distribution (Fig. 17).—Known from Nuevo Leon, Mexico and Guatemala. I have been unable to verify a locality reported by Prout (1918) for Panama. Collecting in higher elevation sites between the Mexican and Guatemalan localities will likely yield additional specimens.

Remarks.—The wing pattern of *P. naxa* is extremely variable. The specimen in Fig. 21 is indistinguishable from one figured by Hering (1928) as "form *fasciata*." I found no genitalic differences between specimens with either this color pattern, or that of the specimen in Figs. 23 and 24, in which there is only a ventral fascia. The specimen most distinct from others, placed in the USNM collection as "form *fasciata*," is shown in Figs. 20, 25 and 26. It is essentially identical



Fig. 14. Overwintering range of *Phryganidia californica*.

in male genitalic morphology to other specimens of *P. naxa* dissected (compare Figs. 18 and 20). The color forms are sympatric at both localities but never differ morphologically.

Although the number of available speci-

mens was small, morphological differences between Mexican and Guatemalan specimens were observed: 1) The vestiture is silver-gray in Mexican specimens and brown-gray in those from Guatemala. 2) The male socii are somewhat more sharply elbowed

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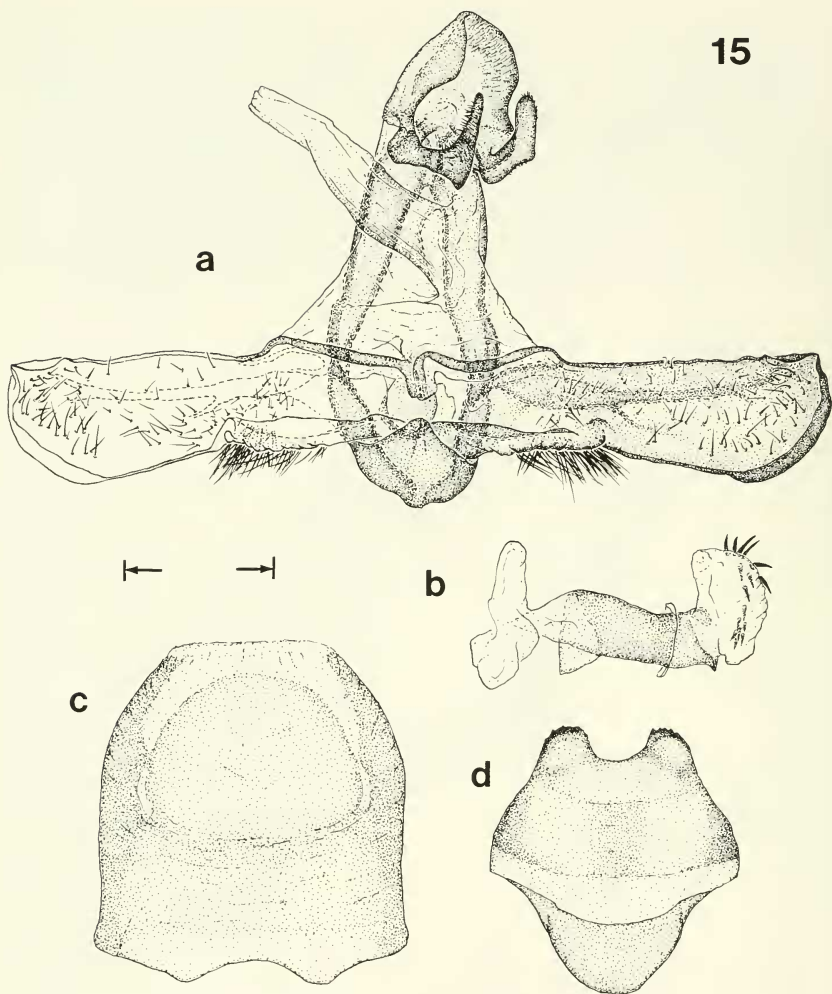


Fig. 15. Male terminalia of *Phryganidia chihuahua* (Mexico, CNC slide no. JSM 112; scale line = 1.0 mm). 15a, Genitalia in anal view with aedeagus removed. 15b, Aedeagus in lateral view (anterior at left). 15c, Tergite VIII in dorsal view. 15d, Sternite VIII in ventral view.

in Mexican specimens than in Guatemalan specimens. 3) In females from Guatemala M_1 is short-stalked with R_{2-5} , whereas it arises from the discal cell in examples from

Mexico. Rather than recognize these as distinct species, I have chosen to wait and see whether collecting in localities between Nuevo Leon and Guatemala yields additional

DISCUSSION



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Fig. 16. *Phryganidia chihuahua* holotype male (Mexico, dorsal view).

specimens. Their discovery may indicate that morphological differences between the northern and southern populations form continuous clines.

Most of the character states described for *Phryganidia* are shared with species in one or more additional dioptid genera. Some are widespread in the family. The combination of wing venational characters found in *Phryganidia*, including the arrangement of the radial veins and stalking of M_3 and CuA_1 in the fore and hind wings, is characteristic of over 270 dioptid species belonging to 14 genera (approximately 68% of the family). This venational pattern does not occur elsewhere in the Noctuoidea and provides perhaps the most convenient means for immediately recognizing the majority of species in the Dioptidae. The only large genus with different venation is *Myonia* (57 species), in



Fig. 17. Geographical distributions of *P. chihuahua* (▲) and *P. naxa* (■).

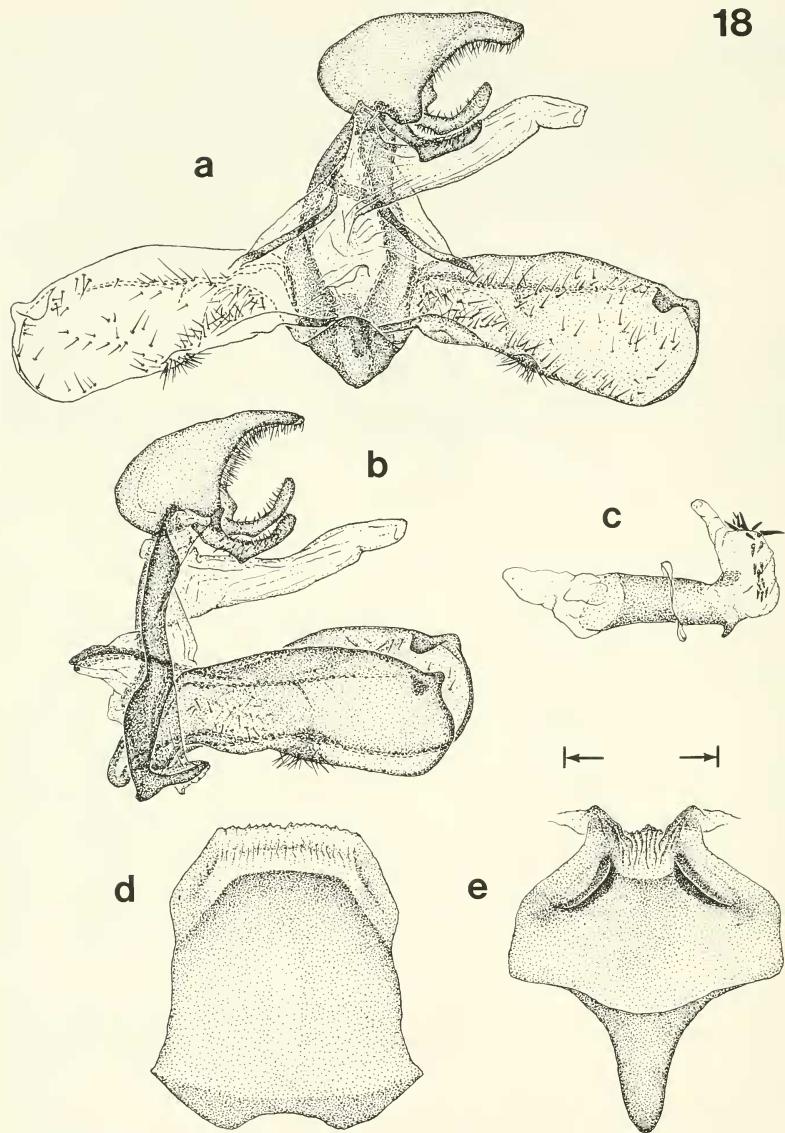


Fig. 18. Male terminalia of *Phryganidia naxa* (Guatemala, USNM slide no. 29174; scale line = 1.0 mm). 18a, Genitalia in anal view with aedeagus removed. 18b, Aedeagus in lateral view (anterior at left). 18c, Genitalia in lateral view (anterior at left). 18d, Tergite VIII in dorsal view. 18e, Sternite VIII in ventral view.

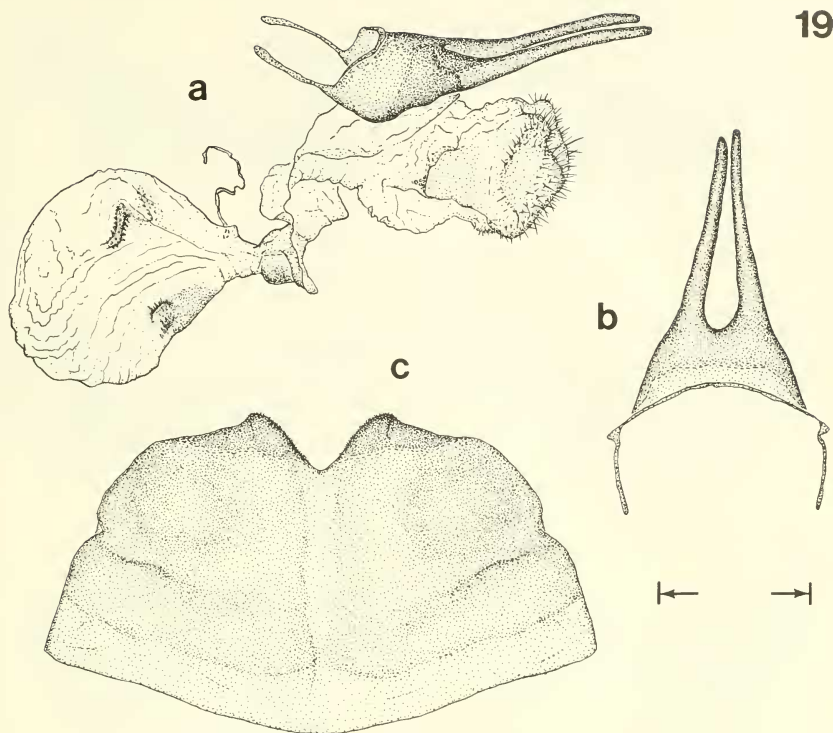


Fig. 19. Female terminalia of *Phryganidia naxa* (Guatemala, USNM slide no. 29176; scale line = 1.0 mm). 19a, Genitalia in lateral view (anterior at left). 19b, Tergite VIII in dorsal view. 19c, Sternite VII in ventral view.

which R_2 and M_3 of the fore wing arise from the discal cell.

Sick (1940) and Kiriakoff (1950a) argued that the tympanum of *Phryganidia* is plesiomorphic within the Dioptidae. In dioptids with a derived tympanal configuration such as *Josia* and related genera, the metathoracic epimeron forms a "pocket" that almost completely encloses the tympanal membrane (figures in Sick and Kiriakoff).

The hook-shaped setae on the abdomen of *Phryganidia* pupae were first noted by Mosher (1916: plate XXVII, fig. 116). I observed identical structures on the abdomen

of pupae in other dioptids, including *Zunacetha annulata* and *Tithraustes demades*. The complete taxonomic distribution of this and other pupal traits will provide invaluable phylogenetic information.

The labial palpi in many dioptid genera are upturned to the dorsal portion of the front (sometimes far beyond), and segment 2 in these cases is extremely long. The presence of relatively short palpi in *Phryganidia* is likely a plesiomorphic character state.

In many Neotropical notodontid genera the sacculus of the male valve is greatly expanded, consisting of a series of "pleats"

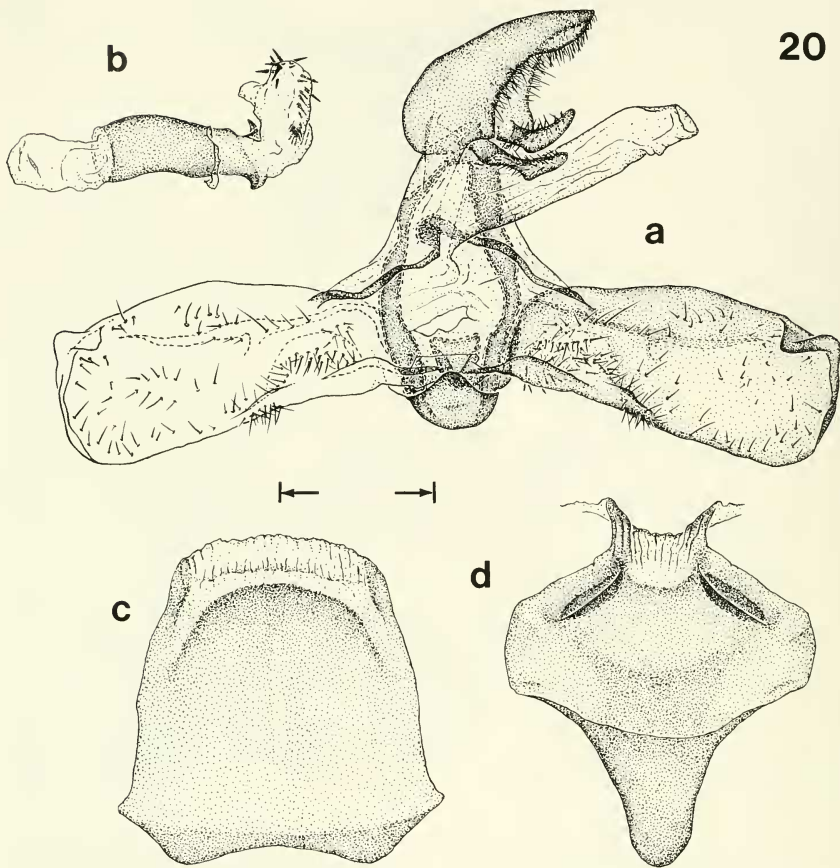


Fig. 20. Male terminalia of *Phryganidia naxa* "form *fasciata*" (Guatemala, USNM slide no. 29175; scale line = 1.0 mm). 20a, Genitalia in anal view with aedeagus removed. 20b, Aedeagus in lateral view (anterior at left). 20c, Tergite VIII in dorsal view. 20d, Sternite VIII in ventral view.

which are associated with long androconial scales (Forbes, 1942; Barth, 1955). Similar valvae occur throughout the Dioptidae. The absence of a pleated sacculus in *Phryganidia* may be a derived state within the family. The transtilla does not join medially in the notodontids I have examined whereas it does in virtually all diopitids. It is not known whether the character state in diopitids is plesiomorphic or apomorphic relative to the

Notodontidae. There is variation in the structure of the transtilla within the Diopitidae as well.

Prout (1918) and Hering (1925) suggested that *Phryganidia* is structurally most similar to species in the genus *Polypoetes*. I observed female genitalic similarities between members of these two genera. However, my research suggests that *Polypoetes* is not monophyletic. A complete understanding



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Figs. 21–26. *Phryganidia naxa*. 21, *P. naxa* male similar to form *fasciata* of Hering (Mexico, UCB; dorsal view). 22, *P. naxa* female lectotype (Guatemala, BMNH; dorsal view). 23, *P. naxa* male (Mexico, UCB; dorsal view). 24, Same specimen (ventral view). 25, *P. naxa* “form *fasciata*” male (Guatemala, USNM; dorsal view; Genitalia, Fig. 20). 26, Same specimen (ventral view).

of *Phryganidia*'s relationship to the other genera will require cladistic analyses, including a thorough investigation of character state distributions throughout the Dioptidae and Notodontidae.

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